```
#include <stdio.h>
#include <pthread.h>
#include <semaphore.h>
#include <unistd.h>

#define MAX_BUFFER_SIZE 5

int buffer[MAX_BUFFER_SIZE];
int in = 0;    // Next free position in buffer
int out = 0;   // Next full position to consume

sem_t empty;   // Counts empty buffer slots
sem_t full;    // Counts full buffer slots
pthread_mutex_t mutex; // Mutex for buffer access

void* producer(void* arg) {
   int item, i;
   for (i = 0; i < 10; i++) {
      item = i + 1; // Produce an item
      sem_wait(&empty);         // Wait if buffer is full
      pthread_mutex_lock(&mutex); // Enter critical section

      buffer[in] = item;
      printf("Producer produced item %d at index %d\n", item, in);
      in = (in + 1) % MAX_BUFFER_SIZE;

      pthread_mutex_unlock(&mutex); // Leave critical section
      sem_post(&full);           // Signal that buffer has new item
```

```
        sleep(1);
    }
    return NULL;
}

void* consumer(void* arg) {
    int item, i;
    for (i = 0; i < 10; i++) {
        sem_wait(&full);            // Wait if buffer is empty
        pthread_mutex_lock(&mutex);  // Enter critical section

        item = buffer[out];
        printf("Consumer consumed item %d from index %d\n", item, out);
        out = (out + 1) % MAX_BUFFER_SIZE;

        pthread_mutex_unlock(&mutex); // Leave critical section
        sem_post(&empty);           // Signal that buffer has empty slot

        sleep(2);
    }
    return NULL;
}

int main() {
    pthread_t prod, cons;

    sem_init(&empty, 0, MAX_BUFFER_SIZE);
```

```
    sem_init(&full, 0, 0);
    pthread_mutex_init(&mutex, NULL);

    pthread_create(&prod, NULL, producer, NULL);
    pthread_create(&cons, NULL, consumer, NULL);

    pthread_join(prod, NULL);
    pthread_join(cons, NULL);

    sem_destroy(&empty);
    sem_destroy(&full);
    pthread_mutex_destroy(&mutex);

    return 0;
}
```

```
Producer produced item 1 at index 0
Consumer consumed item 1 from index 0
Producer produced item 2 at index 1
Producer produced item 3 at index 2
Consumer consumed item 2 from index 1
Producer produced item 4 at index 3
Producer produced item 5 at index 4
Consumer consumed item 3 from index 2
Producer produced item 6 at index 0
Producer produced item 7 at index 1
Consumer consumed item 4 from index 3
Producer produced item 8 at index 2
Producer produced item 9 at index 3
Consumer consumed item 5 from index 4
Producer produced item 10 at index 4
```